STANLEY P. SANDER

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RELEVANT EXPERIENCE

Dr. Sander is a Senior Research Scientist at JPL with more than 40 years of experience in lab kinetics, photochemistry and spectroscopy, instrument development and flight missions with applications to Earth and planetary atmospheres. Current laboratory studies include kinetics of tropospheric reactions of organic peroxy radicals and Criegee biradicals, upper atmospheric radical kinetics of HO_x, NO_x and halogen oxide species, gas-surface reactions relevant to methane on Mars, and hydrocarbon reactions important in Titan's atmosphere. Dr. Sander is Co-Chair of NASA's Panel for Data Evaluation which publishes periodic critical evaluations of laboratory data for atmospheric modeling. Another research focus is remote sensing spectroscopy for atmospheric trace gases and aerosols. He has developed and deployed several atmospheric Fourier transform and dispersive spectrometers at JPL's Table Mountain and CLARS facilities. He is PI and Co-I of NASA technology tasks to develop prototype geostationary imaging Fourier transform spectrometers. He has served on the science teams of several NASA atmospheric composition instruments including UVSI, TES, OCO, OMI and SAGE III. Dr. Sander has over 170 peer-reviewed publications in chemical kinetics, photochemistry, spectroscopy, instrument design and remote sensing. He also serves as the Chief Engineer and Acting Chief Technologist of JPL's Science Division.

EDUCATION

Ph. D., Environmental Engineering Science, California Institute of Technology (1980)
minor in Physical Chemistry

M. S., Environmental Engineering Science, California Institute of Technology (1975)

B. A., Physics, Pomona College, *cum laude* (1974)

AREAS OF EXPERTISE

Laboratory Kinetics and Photochemistry, Chemistry and Composition of Earth and Planetary Atmospheres, Remote Sensing of Atmospheric Composition, Emissions of Trace Gases and Aerosols in Megacities, Satellite and Ground-Based Instrument Technologies (esp. Fourier Transform and Dispersive Spectrometers)

PROFESSIONAL EXPERIENCE

Jet Propulsion Laboratory

Chief Engineer, Acting Chief Technologist, Science Division	2019-present
Senior Research Scientist	1996-present
Manager, Oceanic and Atmospheric Sciences Section	1992-1994
Lead Scientist, Atmospheric Chemistry Research Element	1994-1996
Supervisor, Laboratory Studies and Modeling Group	1998-2016
Research Scientist	1980-1995
Graduate Research Assistant and Part-Time Academic Employee	1971-1980

California Institute of Technology

Visiting Associate in Planetary Science	1998-present
Lecturer in Planetary Science and Env. Engineering Science	2002-2004, 2017
Visiting Associate in Chemical Engineering	1980-1981

University of California, Los Angeles

Visiting Professor, Department of Atmospheric Sciences	1996
Project Scientist, Joint Institute for Regional Earth System Science and Engineering (JIFRESSE)	2008-present

CURRENT RESEARCH PROGRAMS

External

Laboratory Studies of Tropospheric Chemical Reactions, NASA SMD/ESD (P.I.)

Laboratory Studies of Reactions Important for Stratospheric Ozone, NASA SMD/ESD (P.I.)

Ground-Based Remote Sensing of Upper Atmospheric Trace Gases, NASA SMD/ESD (P.I.)

Mechanistic Studies of Benzene Formation in Titan's Atmosphere, NASA SMD/PSD (P.I.)

Validation of SAGE III/ISS Nighttime Measurements of NO_3 and NO_2, NASA SMD/ESD (P.I.)

Quantifying Trends in Methane Emissions in the Los Angeles Basin Using Remote Sensing Spectroscopy at CLARS, California Air Resources Board (P.I.)

Radical Spectroscopy for Interpreting Observations of Triton, Pluto and other Kuiper Belt Objects, NASA/SMD/PSD (Co-I)

Internal

Panchromatic Fourier Transform Spectrometer System Development – SR&TD (P.I.)

Observing System Simulation Experiments for the AURORA mission-SR&TD (co-I)

PAST RESEARCH PROGRAMS (LAST 10 YEARS)

Panchromatic Fourier Transform Spectrometer for the GEO-CAPE Mission, NASA IIP (P.I.)

In-Pixel Digitization ROIC for the GEO-CAPE Mission, NASA ACT (Co-I)

Advanced Onboard Fault-Tolerant Interferogram Processing, NASA AIST (Co-I)

Planetary Major Equipment, NASA PSD (P.I.)

PanFTS Engineering Model for the GEO-CAPE Mission, NASA ESTO IIP (P.I.)

Megacity Carbon Project, NIST Greenhouse Gas Program, (Co-I)

Spatial Distributions of O_3 Precursors and Greenhouse Gases in the LA Basin, CARB, (Co-PI)

Validation of SAGE III/Meteosat Measurements of NO_3, NASA ESD (P.I.)

Mechanisms of CH_4 Oxidation on Mars, JPL R&TD (P.I.P

Retrievals of Aerosol Vertical Profiles Using O_2 Spectropolarimetry, PDRDF (Co-I)

HONORS AND AWARDS

Fellow, American Geophysical Union	2021
NASA Exceptional Achievement Medal	2011, 2015
NASA Exceptional Service Medal	2007

AGU Editor's Citation for Excellence in Refereeing, IEEE Aerospace Conference Best Paper Award (2012), JPL Lew Allen Award for Research, Group Achievement Awards (8), Tech Brief Awards (3).

PROFESSIONAL ACTIVITIES

Chair, NASA Panel for Evaluation of Laboratory Data for Atmospheric Modeling

JPL Technical Equipment, Facilities and Infrastructure Management (TEFIM) Executive Committee

NASA/WMO Ozone Assessment Report Panel

NASA Fluorocarbon Lifetime Assessment Panel

Co-Chair, 23rd Informal Photochemistry Conference, Pasadena, California
Chair, 2001 Gordon Conference on Atmospheric Chemistry, Newport, R.I.
Associate Editor, Journal of Geophysical Research – Atmospheres, 1998
Editorial Board, Internal Journal of Chemical Kinetics, 2000-2002
Proposal Panel Reviewer, NASA/NSF/EPA
Program Office Subject Matter Expert for the NASA EV-M GeoCarb Mission

INSTRUMENT DEVELOPMENT

Fourier Transform Ultraviolet Spectometer (FTUVS). This is a high-resolution UV-visible Fourier Transform Spectrometer (FTS) for measurements of atmospheric trace gases. Spectral resolution is 0.06 cm-1 (resolving power 500,000 at 300 nm) and spectral coverage is 250-1000 nm. The instrument is a plane-mirror design that is dynamically aligned. FTUVS is deployed at Table Mountain Facility and has been in continuous autonomous operation since 1997.

Ozone Spectropolarimeter. A medium resolution grating spectrograph for measurements of the polarization state of near-UV sky radiance. Deployed and operated at JPL for measurements of the vertical profile of ozone in the troposphere.

CLARS Fourier Transform Spectrometer. CLARS-FTS is a high-resolution FTS for remote sensing of greenhouse gases and pollutants located at JPL's California Laboratory for Atmospheric Remote Sensing (CLARS) on Mt. Wilson. This instrument is a corner-cube FTS with 0.02 cm^{-1} resolution (resolving power 750,000 at 600 nm) and operates autonomously in the 600-2500 nm spectral range with linear polarization capability.

Aerosol Polarization Spectrometer. This is a portable FTS based on a Bruker laboratory instrument for measurements of sky polarization in the O_2 A band at 760 nm. The data products are measurements of the vertical concentration profiles of aerosols in the lower atmosphere.

Panchromatic Fourier Transform Spectrometer (Pan-FTS). PanFTS is a very wide-band, high-resolution imaging FTS with spectral coverage from near-UV to TIR. The design is meant to address the requirements for simultaneous remote sensing of multiple trace gases in multiple wavebands to obtain passive retrieval of trace gas vertical profiles. The instrument is specifically designed for deployment in a geostationary or Molniya orbit as a hosted payload on a comsat. A brassboard instrument was constructed under the Instrument Incubator Program and has been successfully tested in the field from Mt. Wilson. A version was proposed for EV-I ("TROMBONE") and was ranked "selectable".

MENTORING (since 1980):

Supervision of 34 postdocs, 12 Caltech graduate students, 8 undergraduates and 2 high school students.

Stanley P. Sander

REFEREED PUBLICATIONS

172. Natraj, V., Luo, M., Blavier, J-F, Payne, V. H., Posselt, D. J., Sander, S. P., Zeng, Z-C, Neu, J. L., Tremblay, D., Wu, L., Roman, J. A., Wu, Y-H and Dorsky, L. I.; Simulated multispectral temperature and atmospheric composition retrievals for the JPL GEO-IR sounder; *Atmos. Meas. Tech.*, **2022,** *15*, 1251-1267 [link]

171. Zhang, X., Berkinsky, D., Markus, C. R., Chitturi, S. R., Grieman, F. J., Okumura, M., Luo, Y., Yung, Y. L. and Sander, S. P.; Reaction of methane and UV-activated perchlorate: Relevance to heterogeneous loss of methane in the atmosphere of Mars; *Icarus*; **2022**, *376*, 114832 [link]

170. Li, K. F., Khoury, R., Pongetti, T. J., Sander, S. P., Mills, F. P. and Yung, Y. L.; Diurnal variability of stratospheric column NO_2 measured using direct solar and lunar spectra over Table Mountain, California (34.38 degrees N); *Atmos. Meas. Tech.*; **2021**, *14*, 7495-7510 [link]

169. Laughner, J. L., Neu, J. L., Schimel, D., Wennberg, P.O., ……., Sander, S. P.; Societal shifts due to COVID-19 reveal large-scale complexities and feedbacks between atmospheric chemistry and climate change; *Proc. Natl. Acad. Sci*; **2021**, *118* [link]

168. Zeng, Z-C, Natraj, V., Xu, F., Chen, S., Gong, F-Y, Pongetti, T. J., Sung, K., Toon, G., Sander, S. P. and Yung, Y. L.; GFIT3: A full physics retrieval algorithm for remote sensing of greenhouse gases in the presence of aerosols; *Atmos. Meas. Tech.*; **2021**, *14*, 6483-6507 [link]

167. Choi, M., Sander, S. P., Spurr, R. J. D., Pongetti, T. J., van Harten, G., Drouin, B. J., Diner, D. J., Crisp, D., Eldering, A., Kalashnikova, O. V., Jiang, J. H., Hyon, J. J. and Fu, D.; Aerosol profiling using radiometric and polarimetric spectral measurements in the O_2 near infrared bands: Estimation of information content and measurement uncertainties; *Remote Sensing of Environment*; **2021**, *253*, 112179 [link]

166. Yang, J., Wen, Y., Wang, Y., Zhang, S., Pinto, J. P., Pennington, E. A., Wang, Z., Wu, Y., Sander, S. P., Jiang, J. H., Hao, J., Yung, Y. L. and Seinfeld, J. H.; From COVID-19 to future electrification: Assessing traffic impacts on air quality by a machine-learning model; *Proc. Natl. Acad. Sci*; **2021,** *118* [link]

165. Addington, O., Zeng, Z-C, Pongetti, R., Shia, R-L, Gurney, K. R., Liang, J, Roest, G., He, L., Yung, Y. L. and Sander, S. P.; Estimating nitrous oxide (N_2O) emissions for the Los Angeles megacity using mountaintop remote sensing observations; *Remote Sensing of Environment*; **2021**, *259*, 112351 [link]

164. Winiberg, F. A. F., Zuraski, K., Liu, Y., Sander, S. P. and Percival, C. J.; Pressure and temperature dependencies of rate coefficients for the reaction $OH + NO_2 + M \rightarrow$ products; *J. Phys. Chem. A*; **2020**, *124*, 10121-10131 [link]

163. Zuraski, K., Hui, A. O., Grieman, F. J., Darby, E., Møller, K. H., Winiberg, F. A. F., Percival, C. J., Smarte, M. D., Okumura, M., Kjaergaard, H. G. and Sander, S. P.; Acetonyl peroxy and hydro peroxy self- and cross-reactions: kinetics, mechanism, and chaperone enhancement from the perspective of the hydroxyl radical product; *J. Phys. Chem. A*; **2020,** *124*, 8128-8143 [link]

162. Wang, S., Li, K-F, Zhu, D., Sander, S. P., Yung, Y. L., Pazmino, A. and Querel, R.; Solar 11-Year cycle signal in stratospheric nitrogen dioxide—similarities and discrepancies between model and NDACC observations; *Solar Phys.*; **2020**, *295* [link]

161. Zeng, Z-C, Wang, Y., Pongetti, T. J., Gong, F-Y, Newman, S., Li, Y., Natraj, V., Shia, R-L, Yung, Y. L. and Sander, S. P.; Tracking the atmospheric pulse of a North American megacity from a mountaintop remote sensing observatory; *Remote Sensing of Environment*; **2020**, *248* [link]

160. Cusworth, D. H., Duren, R. M., Yadav, V., Thorpe, A. K., Verhulst, K., Sander, S., Hopkins, F., Rafiq, T. and Miller, C. E.; Synthesis of methane observations across scales: strategies for deploying a multitiered observing network; *Geophys. Res. Lett.;***2020** [link]

159. Zeng, Z-C, Xu, F., Natraj, V., Pongetti, T. J., Shia, R-L, Zhang, Q., Sander, S. P. and Yung, Y. L.; Remote sensing of angular scattering effect of aerosols in a North American megacity; *Remote Sensing of Environment*; **2020**, [link]

158. Wang, J., Zhou, M., Xu, X., Roudini, S., Sander, S. P., Pongetti, T. J., Miller, S. D., Reid, J. S., Hyer, E. and Spurr, R.; Development of a nighttime shortwave radiative transfer model for remote sensing of nocturnal aerosols and fires from VIIRS; *Remote Sensing of Environment*; **2020**, *242* [link]

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154. He, L., Zeng, Z.-C., Pongetti, T. J., Wong, C., Liang, J., Gurney, K. R., Newman, S., Yadav, V., Verhulst, K., Miller, C. E., Duren, R., Frankenberg, C., Wennberg, P. O., Shia, R.-L., Yung, Y. L. and Sander, S. P.; Atmospheric methane emissions correlate

with natural gas consumption from residential and commercial sectors in Los Angeles; *Geophys. Res. Lett.;* **2019** [link]

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152. Winiberg, F. A. F., Percival, C. J. and Sander, S. P.; Quantification of nitric acid using photolysis induced fluorescence for use in chemical kinetic studies; *Chem. Phys. Lett.*; **2019** [link]

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141. Bloom, A. A.; Lauvaux, T.; Yadav, V.; Duren, R.; Sander, S.; Worden, J.; Schimel, D.; Resolving biogeochemical controls on greenhouse fluxes from space: a case study on Amazon wetland emissions; *Atmos. Chem. Phys.*; http://dx.doi.org/10.5194/acp-16-15199-2016.

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